Space-time rotations and isobaric spin

van Winter, Clasine

SUMMARY

After some preparatory work on rotations and generalized Eulerian angles, the transformations of special relativity are discussed in terms of six Eulerian angles in Minkowski space. Families of functions Z are constructed which transform linearly among themselves under rotations in space-time as well as under spatial reflection. It is found that for any finite-dimensional representation of the full Lorentz group there exist several families of functions Z, which are distinguished from each other by two family-indices. The family-indices are shown to be the eigenvalues of a new three-dimensional angular-momentum operator, S', and of one component thereof. Any component of S' commutes with any operator which generates an ordinary Lorentz transformation. It is essential that the eigenvalues of S' are integral for one-valued, half-integral for two-valued representations of the Lorentz group.

If the six Eulerian angles are interpreted as spin variables, spinors can be replaced by functions Z. In a formalism in which wave functions for spinning particles are expressed in terms of functions Z, the eigenvalues of S' should be integral for bosons, half-integral for fermions. In such a formalism the angular momentum S' commutes with any operator which occurs in the theory of free particles. It is now suggested that S' might represent a new spin. More particularly, S' is tentatively interpreted as the isobaric spin. In view of the connection between S' and the spin, this interpretation is incompatible with the isobaric-spin classification of heavy unstable particles which has been proposed by Gell-Mann (1953) and by Nakano and Nishijima (1953). However, it is pointed out that the present state of our experimental knowledge does not yet permit a decision in favour of any particular isobaric-spin classification. Much experimental and theoretical work will be required before the possible interpretation of S' can be established.